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Development and Manufacturing Centre

SERVICE MANUAL
742
UNIT

Modifikation kit
kV Cont. Rel 3.2 OPT RAD

Techn. No. 4512 104 91941

kV Cont. Rel 1.2 OPT R/F

Techn. No. 4512 104 91951

DMC Hamburg

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SERVICE MANUAL - UNIT

Modification kit kV Cont Rel 3.2 OPT RAD 4512 104 91941
Modification kit kV Cont Rel 3.2 OPT R/F 4512 104 91951

Author: K.-H. Hamburg

In case there are any questions concerning this manual,
please send this LOPAD via fax to 49/(0)40/5078 2481

File: MK_KV_control.doc

List of pages and drawings (LOPAD) **Manual Order No: 4512 984 23131**

1	(00.0)	
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6-1...6-4	(00.0)	OPTIMUS RAD / R/F / C
2-1...2-3	(00.0)	OPTIMUS RAD / R/F / C
2-1...2-3	(00.0)	OPTIMUS RAD / R/F
2-1...2-2	(00.0)	OPTIMUS C

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This manual belongs to FCO 00 135 014 'FW Update kV_Control Rel x.2 OPTIMUS RAD / RF / C'

Kit FW kV Cont Rel 3.2 OPT RAD 4512 104 91941:

Pos1	PROM kV Control RD	4512 113 20132
Pos 850	Instruction Man FW kV_CONTRL	4512 984 23131
Pos 860	FCO sheet 00 135 014	4512 980 58361

Kit FW kV Cont Rel 1.2 OPT R/F 4512 104 91951:

Pos1	PROM kV Control RD	4512 113 26212
Pos 850	Instruction Man FW kV_CONTRL	4512 984 23131
Pos 860	FCO sheet 00 135 014	4512 980 58361

1. Modification Instructions:

Caution !
Use proper ESD grounding techniques when handling components. Wear an antistatic wrist strap and use an ESD-protected mat. Store ESD-sensitive components in antistatic bags before placing them on any surface.

- Switch OFF the generator.

1.1. Identify the generator type RAD, R/F or C via master card:

The description of the item HV TRANSFORMER indicates
either <HE-H x ARB. XRG 90 **RAD**> for RAD
or <HE-H x ARB. XRG 90 **R/F**> for R/F **and C**

Exchange the PROM D800 on PCB kV_Control_4 EZ130 4512 108 0910x

Note: only double converter units 65/80kW with CU Rel 3* Optimus RAD & R/F
with CU Rel 1.1** Optimus C

Generator type:	**PROM on KV_Control_4**	
	Remove	**Insert**
Optimus 65/80 ***RAD Cu Rel 3**** <HE-H x ARB. XRG 90 **RAD**>	PROM: 4512 113 **20121** or PROM: 4512 113 **20131**	PROM: 4512 113 **20132** **FW kV-Control RD**
Optimus 65/80 ***R/F Cu Rel 3**** <HE-H x ARB. XRG 90 **R/F**>	PROM: 4512 113 **26211** or PROM: 4512 113 2**0121** or PROM: 4512 113 **20131**	PROM: 4512 113 **26212** **FW kV-Control R/F**
Optimus 65/80 ***C Cu Rel 1.1**** <HE-H x ARB. XRG 90 **R/F**>	PROM: 4512 113 **26211**	PROM: 4512 113 **26212** **FW kV-Control R/F**

Note: The former FCO 00 135 006 must be implemented in concerned generators, except the section 6 'Exchange of kV-Control PROM' will be overruled by this step.

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Check mains programming

- Measure the mains voltage at ENF1:

L1 - L2	L2 - L3	L1 - L3
U=	U=	U=

XRGSCOPE:

- Set the mains voltage according to the measured value above:

OPTIMUS PROGRAMM MAINS DATA 380 / 400 / 440 / 460 / 480V

Note: A wrong mains programming might lead to a damage of the power converter!

Warm up the tube for duty cycle adjustment

Due to need of a high load for the duty cycle adjustment it will be done with 141kV. To avoid an arcing it is highly recommend to warm up the tube.

- Conduct the first three sequences (80kV, 90 kV, and 100kV) according to the section 'Conditioning of the tube', refer to attach_2 of this manual.

Adjust the factor for duty cycle

- Refer to revised section 2.0 in attach_1 of this manual.

1. After ending the adjustment do NOT forget to remove the short link from the PCB EZ 130!!

File the section attach_1 into chapter ADJUSTMENTS of the Service Manual Subsystem OPTIMUS.

Run conditioning of the tube(s) on large focus

- This procedure at this sequence of FCO is to make sure the tube will not arc for the following adjustments. Refer to revised section 1x.1 in attach_2.

- File the section attach_2 into chapter INSTALLATION of the Service Manual Subsystem OPTIMUS or System Manual Installation.

Run adaptation of the tube(s) for small and large focus

- Optimus RAD & R/F: refer to revised section 1x.2 in attach_3.
  Note the special instructions for BuckyTH2 or Easy Diagnost with BuCo Rel 5.x or Thoravision.
- Optimus C: refer to revised section 10.2 in attach_4.

- File this attach_3 or _4 into chapter INSTALLATION of the Service Manual Subsystem OPTIMUS or System Manual Installation.

File this mod_instruction manual and the FCO sheet into chapter SERVICE INFORMATION of the Service Manual Subsystem OPTIMUS.

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Note: This revised section must be filed into the Customer's Service Manual to replace the existing Alignment of "Function Unit kV"**!**

2. Alignment of "Function Unit kV"

2.1. General information

The actual value of the set kV shall be attained at least after 2 ms. At kV rise phase there shall be no kV break-in nor a kV overshoot.

The "factor for duty cycle" is based on an adapted tube and determines at local mains voltage and mains resistance conditions

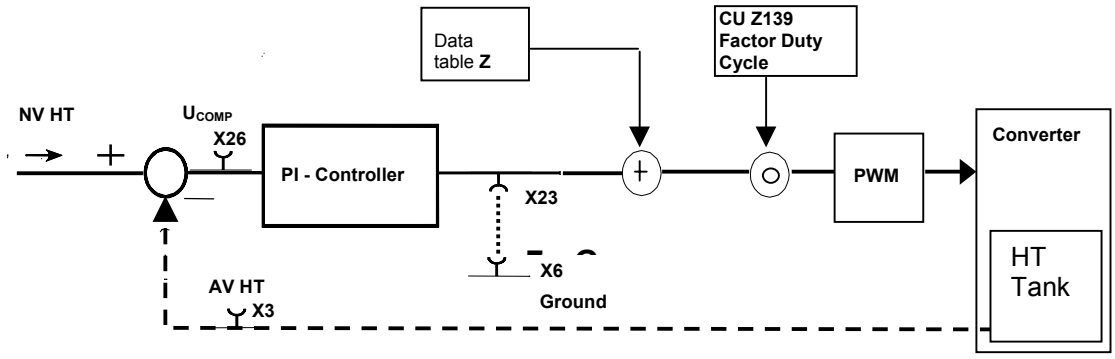
- the kV rise phase and
- the kV behaviour during the exposure in falling load technique

as it takes into account the tolerances of the following FRU's:

PCB EZ 130			✳✳
kV_control_3 = 50kW	1 converter	4512 108 0908x	
kV_control_4 = 65/80kW	2 converters	4512 108 0910x	
a complete power converter unit Q			✳✳
kV_power PCB(s) Q100	(part of the power converter unit)		
IGBT transistors	(part of the power converter unit)		
resonance capacitors	(part of the power converter unit)		✳✳
high tension transformer			✳✳

An exchange of one of the ✳✳ marked parts requires a realignment of the "factor for duty cycle"

The "factor for duty cycle" is stored in the memory of PCB CU EZ139. If CU has to be replaced one can reload the CU Complete backup (with the actual factor) to the NVRAM memory or one has to re-align the "factor for duty cycle".



During alignment this "factor for duty cycle" must be entered via XRGSCOPE. The influence of this factor as a correction value for the Z-data table will be monitored as the U_{COMP} signal, since the PI controller is deactivated by the grounded GAIN_IN signal.

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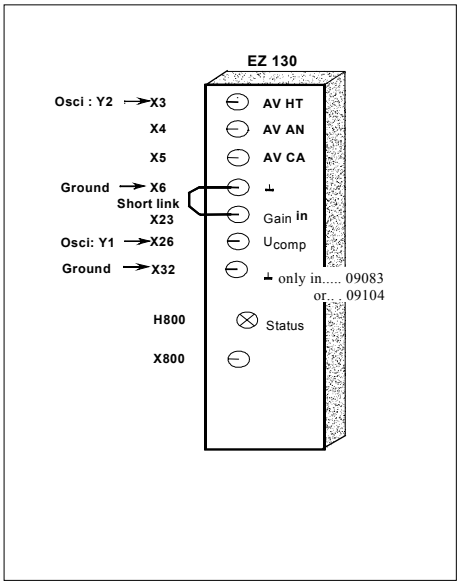
Connect and set the scope

Channel 1 = EZ130 X3 AVHT 20kV/V 1V/div Zero-line at bottom of screen
Channel 2 = EZ130 X26 U_{COMP} 1V/div Zero-line 2 div from bottom of screen
Ground = EZ130 X6 *GNDA* all PCB versions
EZ130 X32 GNDA PCB ≥ 4512 108 0908**3** kV_3 (50kW)
PCB ≥ 4512 108 0910**4** kV_4 (65/80kW)



Trigger = external (preferred) *CTRL_X_C/* backpanel EZ X74
\ negative slope
or internal channel 1 *AVHT* EZ 130 X3 / positive slope at +3V

Time base = 5 or 10ms/div trigger delay -1div

Note: A Digital scope should not have any other ground connection than the ground of the probe.
A Mains driven scope must be isolated from earth potential, otherwise it might display artefacts.

Deactivate kV controller

- Connect EZ130 X23 GAIN_IN and X6 GNDA with a short link (use a short wire).

Caution: This alignment requires an exposure with high kV!
Be sure the tube has been warmed up before.

Set exposure data

Notes:
- Apply this adjustment at the tube that has the highest kV limit programmed.
- a) Standard: If the tube limit is 150kV →carry out the duty cycle factor adjustment with 141kV;
  b) Special: in case the programmed application limit of the only tube is 125 kV →use **special** setting for this adjustment.
- Any tube arcing during this adjustment requires to execute the tube conditioning next (new procedure is attached). Start over this adjustment if the tube becomes stable.

- Set kV and mA values according to the programmed tube limits:

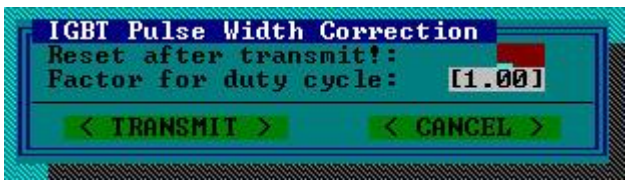
a) Standard:	141kV	100 mA	at	kV_3	(50kW)
		200 mA	at	kV_4	(65/80kW)
b) Special:	125kV	100 mA	at	kV_3	(50kW)
		200 mA	at	kV_4	(65/80kW)

Set exposure time: 40ms

Adjust the "factor for duty cycle" via service software XRGSCOPE by measuring U_{COMP} with the scope.

- Connect the service PC and start XRGSCOPE:

XRGSCOPE
SELECT UNIT→FU-kV→ADJUST→IGBT Pulse Width Correction→ Factor for duty cycle:



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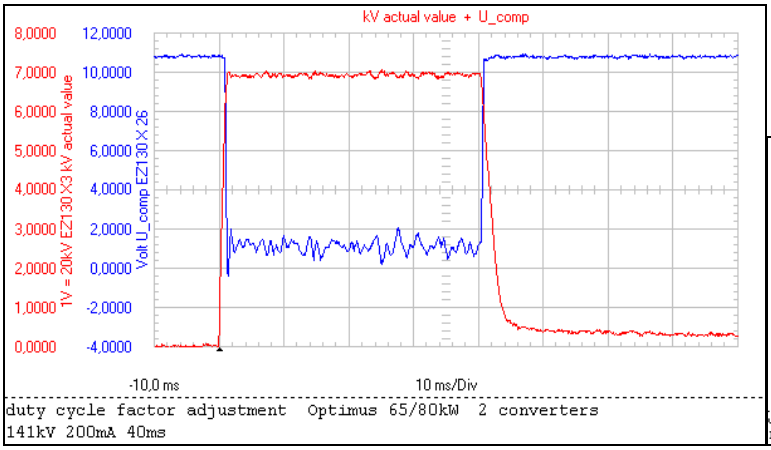
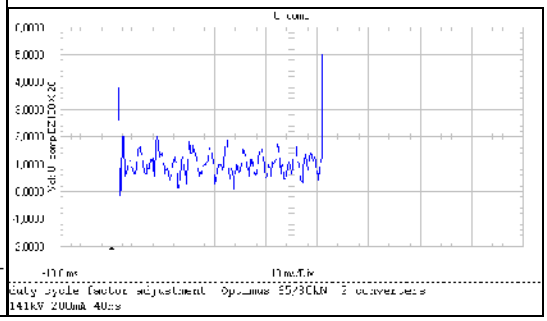
- Set the starting value "Factor for duty cycle" to **1.00**

Note: If the U_{COMP} value does not match the requirements type in another "Factor for duty cycle" value, <TRANSMIT> the screen and push the active RGDV button to get the new value validated.

- Switch an exposure.
  The values are measured in the stationary condition. The transient behaviour at the beginning of the exposure is not taken into account.
  Result: In standby the U_{COMP} value is at about +11V, during exposure the mean value U_{COMP} shall be as given in table 1a or 1b, refer to picture 1:



picture 1 oscillogram of a perfect alignment for 141 kV



picture 4 U_{COMP} for 141 kV

a) Standard setting 141kV:

- Read the mean value of U_{COMP} for 141kV (see scope picture 2 or 4), correct the factor for duty cycle till U_{COMP} meets the required reference of + 1Volt.

kV setpoint	mA setpoint	PCB type	**U_{COMP}**	tolerance	KV peak of *AVHT*	**Factor for duty cycle**	**Date:**
141 kV	100 mA	**PCB kV_control 3:**	**+ 1V**	+1V / - 0,5V	138 kV		
141 kV	200 mA	**PCB kV_control 4:**	**+ 1V**	± 0.5V	138 kV		

Table 1a: duty cycle factor, settings 141kV (150kV limit)

Example how to correct the factor for duty cycle:

- **PCB kV_control 3:**
  If the mean value of U_{COMP} is
  > + 2 V **increase** the factor for duty cycle by increment of 0.01
  < + 0.5 V **decrease** the factor for duty cycle in steps of 0.01

- **PCB kV_control 4:**
  If the mean value of U_{COMP} is
  > + 1.5 V **increase** the factor for duty cycle in steps of 0.01
  < + 0.5 V **decrease** the factor for duty cycle in steps of 0.01

- Check also the kV peak value AVHT (not the overshoot), it shall be
  138kV **for 141kV** setpoint (see scope picture 3)

- Remove short link EZ130 X23 GAIN_IN.

- Record the findings in table1a.

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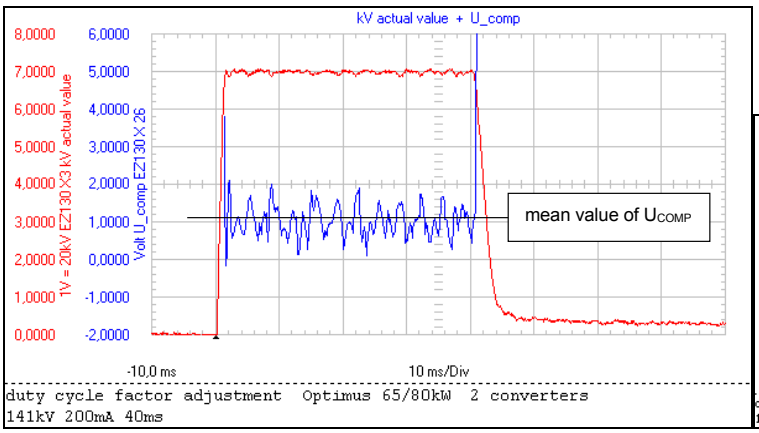
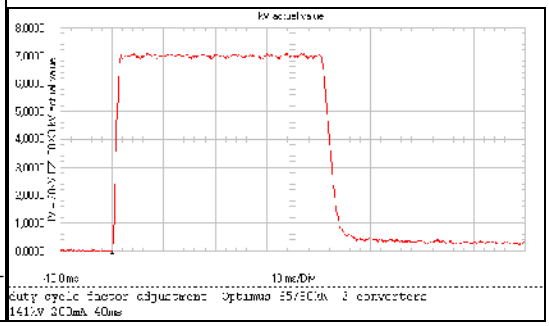

kV actual value + U_comp
mean value of U_COMP
-10,0 ms
10 ms/Div
duty cycle factor adjustment Optimus 65/80kW 2 converters
141kV 200mA 40ms



picture 2 Optimus 80kW with 141 kV, U_{COMP} = +1V picture 3
HTAV without overshoot

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b) Special setting 125 kV: in case there is no other tube connected that stays for higher kV.

- Read the mean value of U_{COMP} for 125kV (in principle picture 2 or 4)
- Correct the factor for duty cycle till U_{COMP} meets the required reference of 0 Volt.

kV setpoint	mA setpoint	PCB type	**U_{COMP}**	tolerance	KV peak of AVHT	**Factor for duty cycle**	**Date:**
125 kV	100 mA	**PCB kV_control 3:**	**+ 0V**	+1V / - 0,5V	125 kV		
125 kV	200 mA	**PCB kV_control 4:**	**+ 0V**	± 0.5V	125 kV		

Table 1b: duty cycle faktor 125 kV limit

Example how to correct the factor for duty cycle:

- **PCB kV_control 3:**
  If the mean value of U_{COMP} is
  > + 1 V **increase** the factor for duty cycle in steps of 0.01
  < - 0.5 V **decrease** the factor for duty cycle in steps of 0.01

- **PCB kV_control 4:**
  If the mean value of U_{COMP} is
  > + 0.5 V **increase** the factor for duty cycle in steps of 0.01
  < - 0.5 V **decrease** the factor for duty cycle in steps of 0.01

- Check also the kV peak value AVHT (not the overshoot), it shall be **125kV for 125kV** setpoint.
- Remove short link EZ130 X23 GAIN_IN.
- Record the findings in table 1b.

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Note: This revised section must be filed into the Customer's Service Manual, it does replace the existing section ‚Tube Conditioning'.

10.3 Conditioning of the tube(s)

Warning!

Radiation is released during the procedure!

This procedure must be performed for each new installation, tube replacement, but also if a symptom points to any kind of tube arcing.

Precondiontions / Programmings:

For Optimus RAD & R/F (CU release 3.x)

- Perform the following programmings temporarily for each tube connected to one of the assigned RGDV = Free cassette:

XRGSCOPE
PROGRAM→REGISTRATION DEVICES→RGDV#→DATA SET A:

	Temporarily:	Original:Tube1,2,3
Enable handswitch....	**YES**	Verify the
Synchmaster present	**NO**	custimezed
Exposure switch type	**Double Step**	entries
Exposure series / Tomo...	**YES**	in 2Z-2.x
Mounted radiographical..	**NONE**	

- Reset the generator
- Select appropriate programmed RGDV 'Free cassette' for each tube to be break in.

For Optimus C (Duo Diagnost)

Note: No change of programming is required.

- Select Registration Device ‚Free cassette' for this tube.

Procedure:

- Select large focus

Note: The generator must be in the READY state.

- Run reconditioning procedure for an adapted tube, refer to the table 'Exposure data set for conditioning', left column 'Tube adapted'.

or

- Run conditioning procedure for a new or non-adapted tube, refer to the table 'Exposure data set for conditioning' , right column 'Tube not adapted'.

- It is recommended to monitor the high tension during conditioning. Connect the scope:
  Channel1: kV *AV HT* at EZ 130 X3 (1V/div), scale: 20kV/V
  Trigger external: *CTRL_X_C/* at backpanel EZ X74, negative slope
  Time base: 2ms/div.

- In case of problems like tube arching see flowchart 'Exposure sequence' as an example, apply for applicable kV range only:
  i.e. 109 kV is the max kV value for normal application, perform just up to next higher kV step = 117kV.

Notes (refer to flow chart 'Exposure sequence'): If the tube arcs at a certain kV value, conduct another 3 exposures with same parameters and 10 s pause between subsequent exposures. In case of success (no arcing anymore) continue with next kV step of the table "Exposure data set...".
If the last exposure still arcs go one kV step back and follow normal procedure. If this routine has been performed three times without improvement; → replace the tube.

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Exposure parameter for conditining					
Tube adapted				Tube not adapted	
kV	mA	ms	# exposures	kV	mAs
80	10	50	< 1 >	80	0.5
80	10	500	< 1 >	80	5
80	200	250	< 1 >	80	50
10 seconds pause				10 seconds pause	
80	max mA	100	< 1 >	80	100
1 minute pause				1 minute pause	
90	10	50	< 1 >	90	0.5
90	10	500	< 1 >	90	5
90	200	250	< 1 >	90	50
10 seconds pause				10 seconds pause	
90	max mA	100	< 1 >	90	100
1 minute pause				1 minute pause	
100	10	50	< 1 >	100	0.5
100	10	500	< 1 >	100	5
100	200	250	< 1 >	100	50
10 seconds pause				10 seconds pause	
100	max mA	100	< 1 >	100	100
1 minute pause				1 minute pause	
110	10	50	< 1 >	110	0.5
110	10	500	< 1 >	110	5
110	200	250	< 1 >	110	50
10 seconds pause				10 seconds pause	
110	max mA	100	< 1 >	110	100
1 minute pause				1 minute pause	
120	10	50	< 1 >	120	0.5
120	10	500	< 1 >	120	5
120	200	250	< 1 >	120	50
10 seconds pause				10 seconds pause	
120	max mA	100	< 1 >	120	100
1 minute pause				1 minute pause	
130	10	50	< 1 >	130	0.5
130	10	500	< 1 >	130	5
130	200	250	< 1 >	130	50
10 seconds pause				10 seconds pause	
130	max mA	100	< 1 >	130	100
1 minute pause				1 minute pause	
140*	10	50	< 1 >	140*	0.5
140*	10	500	< 1 >	140*	5
140*	200	250	< 1 >	140*	50
10 seconds pause				10 seconds pause	
140*	max mA	100	< 1 >	140*	100
1 minute pause				1 minute pause	
145*	10	50	< 1 >	145	0.5
145*	10	500	< 1 >	145	5
145*	200	250	< 1 >	145	50
10 seconds pause				10 seconds pause	
145*	max mA	100	< 1 >	145	100
1 minute pause				1 minute pause	
148*	10	50	< 1 >	148	0.5
148*	10	500	< 1 >	148	5
148*	200	250	< 1 >	148	50
10 seconds pause				10 seconds pause	
148*	max mA	100	< 1 >	148	100
1 minute pause				1 minute pause	
150*	10	50	< 1 >	150	0.5
150*	10	500	< 1 >	150	5
150*	200	250	< 1 >	150	50
10 seconds pause				10 seconds pause	
150*	max mA	100	< 1 >	150	100

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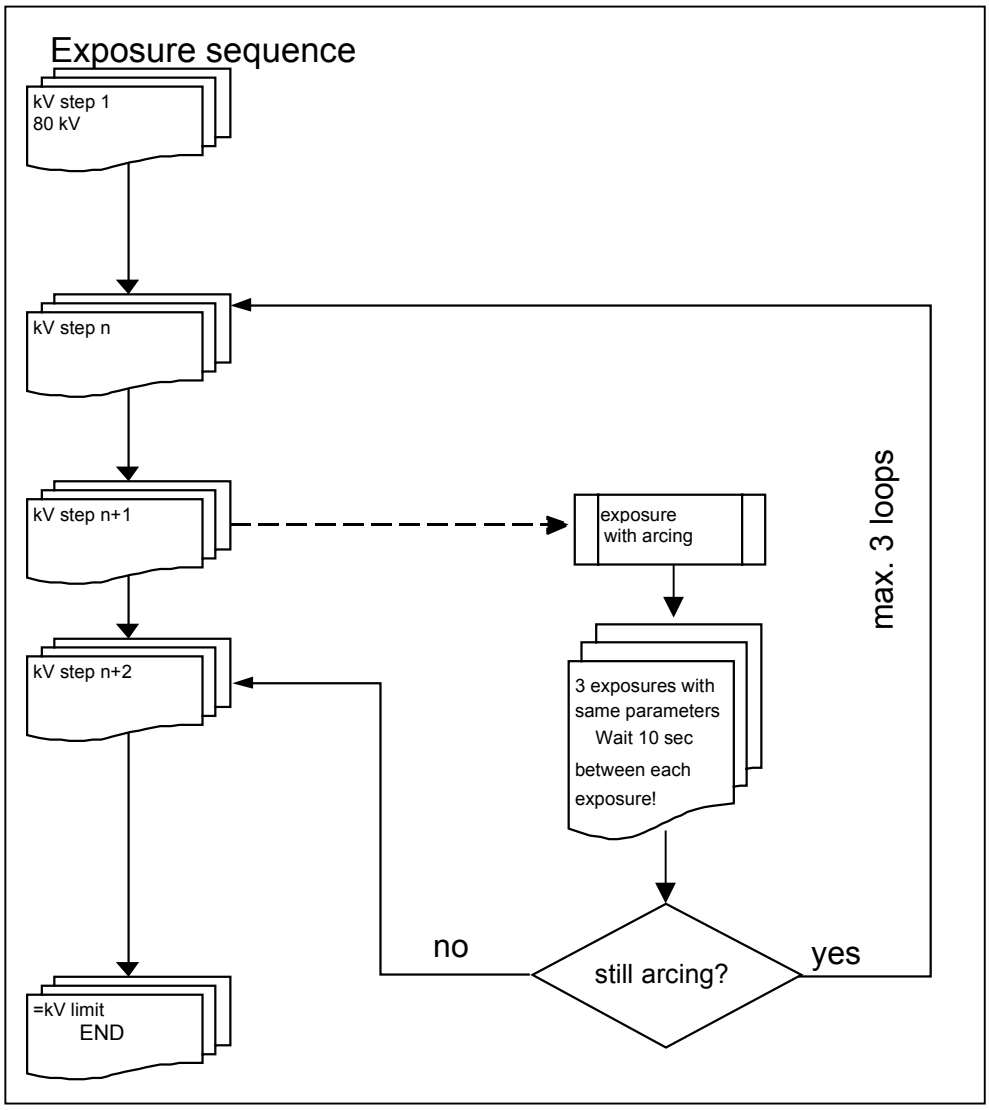

Note: If a tube arcs at a kV value which is not required for application the max kV (e.g.117kV) program this new limit value via

XRGSCOPE
Program → Tubes → Tube Limits → Max. Tube Voltage Limit [kV]: [**117**].

Since the limit value got reduced by this reason, a following re-adaptation procedure will set the field *‚Adapted To [kV]'* to this value as well.

- Set RGDV programming to original status if no adaptation procedure has to be executed.
- Reset the generator

(Note: If adjustment 'factor for duty cycle' was interrupted by tube arcing, return to that procedure now.)

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Note: This revised section must be filed into the Customer's Service Manual to replace the existing section ‚Tube Adaptation'.

10.4. Adaptation of the tube for Optimus RAD & R/F

⚠ **Warning!**

Radiation is released during the following procedure!

General information:

Tube adaptation is an automatic process which includes

1) the measurement of the mA offset value that is caused by
   - the kV measuring circuit
   - the emission current feedback circuit (VCO)
2) the measurement of the individual standby filament current (based on 100uA)
3) the emission current characteristic as f (kV , filament current)
4) the dynamic behaviour (positive and negative boost adaptation where the inertia of the filament with respect to heating up and cooling down is registered (for more info refer to chapter FAULTFINDING).

Note: In case of problems check the symptom / solution list at the end of this adaptation section. Repeat the adaptation for this particular focus.

Precondiontions and Programmings:

- The tube should be conditioned, refer to section 'Conditioning of the tube(s)'

- Check the upper kV limit
  XRGSCOPE: Program → Tubes →Tube Limits →Max. Tube Voltage Limit [kV]:

The programmed value should match the nominal value of the tube connected or in case of older tubes the upper kV limit should be set to the max application kV.
Once an adaptation is completed the new limit value will be indicated as *‚Adapted To [kV]'.*

- Perform the following programming temporarily at RGDV(s), 'Free Cassette' which is assigned to the tube(s):
  XRGSCOPE: PROGRAM →REGISTRATION DEVICES →RGDV# →DATA SET A:

	Temporarily:	Original:Tube1,2,3
Enable handswitch....	**YES**	Verify the
Synchmaster present	**NO**	custimezed
Exposure switch type	**Double Step**	entries
Exposure series / Tomo...	**YES**	in 2Z-2.x
Mounted radiographical..	**NONE**	

Special Notes

For Bucky TH2, Easy Diagnost with BuCo Rel ≥ 5.x and Thoravision:

- Remove the Signal Bus connector EZX 23 at the generator side for this procedure.
  The adaptation must be performed at RGDV 'Free cassette':
  Bucky TH2: select RGDV 4 Bucky Unit Easy Diag: select RGDV 8 Thoravision: select RGDV 2

Procedure:

- Reset the generator

- It is recommended to monitor the high tension during conditioning. Connect the scope:
  Channel1: kV *AV HT* at EZ 130 X3 (1V/div), scale: 20kV/V
  Trigger external: *CTRL_X_C/* at backpanel EZ X74, negative slope
  Time base: 2ms/div.

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- Select the 'Free cassette' RGDV for the tube to be adapted.

- XRGSCOPE →Optimus XRG →Adjust →Tube Adaptation

  Select the tube and focus to be adapted, start with small focus!

  Note: To avoid any malfunction make sure that 'READY' is displayed on the desk before pressing <TRANSMIT> F2!

- Press F2:
  Ready state disappears, **'Adap'** is displayed on the desk, **"Waiting"** is displayed on the PC screen. Wait until the generator turns back to READY state.

- Start the adaptation process by pressing the handswitch in PREP and EXP position continously.

  The generator will switch about 125 exposures for each focus. The radiation sign at the desk will indicate exposures but there will be no beep at the end of each exposure.
  The actual kV parameters are displayed during adaptation.

  The generator carries out the adaptation automatically. The procedure for one focus is completed when the desk indication changes from **'Adap'** to **'Test'**. The **"Waiting"** message disappears from the PC screen together with a PC beep, followed by the screen
  "Before continuing the generator must be reset".

- Reset the generator

- Run the adaptation for each focus (small and large) and tube.

Note: As there is no tube type with a physical third (middle) focus yet, so it can not be adapted.
VARIOfocus values are calculated by adapted small and large focus. APR programs using VARIOfocus can only be selected until small and large focus are both adapted.

- Set RGDV(s) programming to original status according 'RGDV progamming' 2Z-2.

! In case of Bucky TH2, Easy Diagnost with Bucky Unit or Thoravision:

- Switch OFF the generator, reestablish the Signal bus EZX 23 and switch ON the generator.

- All other systems: Reset the generator.

<u>Symptoms and solutions if problems occur during adaptation</u>:

1. A Warning can not be displayed on the control desk, the "Waiting" screen on the PC is flickering instead during this event and logged in the error log index.

2. If the tube is already on a high temperature level (but the traffic light still indicates green or green-yellow for 100% power) it might happen that the traffic light changes straight to red and the adaptation is on hold**.**
   "Waiting" is flickering on the PC.
   Solution: Keep the handswitch pressed, once the temperature is down adaptation continues automatically
   Note: An increment of one of the temperature levels inhibits the 100% power condition. This event is always logged as Warning 00BV in the error log index.

3. An Error message will just flash for a very short moment and instantly covered by **'Adap'** afterwards.
   "Waiting" is flickering on the PC.

- All buttons at the control desk including the "reset" button are inactive during adaptation.
  The only way to reset an error is: to release the PREP switch which causes an interrupt, (similar to the "reset" command.)

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4. After let go of the PREP switch wait until the desk indicates READY. If READY does not appear at least after 20 seconds run a warmstart of the generator via the reset button on CU EZ139.

5. If adaptation seems to do nothing for more than 30 seconds let go the PREP switch. Wait until the desk indicates READY. If READY does not appear at least after 20 seconds run a warmstart of the generator.

6. If a constant READY indication appears for more than 2 seconds while PREP and EXP is activated with the handswitch during adaptation let go the handswitch. Wait until the desk indicates READY. If READY does not appear at least after 20 seconds run a warmstart of the generator.

7. If adaptation does not carry on with or without READY indication check if one of the funcion units indicates a FATAL error by turning on the red LED. Let go the handswitch and warmstart the generator.

8. If adaptation has been interrupted by a generator warmstart check the error log index before restarting adaptation:
   kV errors 02WG and/or 02WH indicate tube arcing. Run conditioning of the tube and/or reduce the max kV value to the required application value.

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Note: This revised section must be filed into the Customer's Service Manual to replace the existing section ‚Tube Adaptation'.

10.4. Adaptation of the tube for Optimus C

Warning!

Radiation is released during the procedure!

General information:

Tube adaptation is an automatic process which includes

1) the measurement of the mA offset value that is caused by
   - the kV measuring circuit
   - the emission current feedback circuit (VCO)
2) the measurement of the individual standby filament current (based on 100uA)
3) the emission current characteristic as f (kV , filament current)
4) the dynamic behaviour (positive and negative boost adaptation where the inertia of the filament with respect to heating up and cooling down is registered, for more info refer to chapter FAULTFINDING).

Note: In case of problems check the symptom / solution list at the end of this adaptation section. Repeat the adaptation for this particular focus.

Precondiontions and Programmings:

The tube should be conditioned, refer to section 'Conditioning of the tube(s)'

- Check the upper kV limit
  XRGSCOPE: Program → Tubes →Tube Limits →Max. Tube Voltage Limit [kV]:

The programmed value should match the nominal value of the tube connected or in case of older tubes the upper kV limit should be set to the max application kV.

- Once an adaptation is completed the new limit value will be indicated as *‚Adapted To [kV]'.*

Procedure:

- It is recommended to monitor the high tension during adaptation. Connect the scope:
  Channel1: kV *AV HT* at EZ 130 X3 (1V/div), scale: 20kV/V
  Trigger external: *CTRL_X_C/* at backpanel EZ X74, negative slope
  Time base: 2ms/div.

- Select menu XRGSCOPE →Optimus C →Adjust →Tube Adaptation

- Select only Tube 1 and the focus to be adapted, start with small focus!

Note: To avoid any malfunction make sure that 'READY' is displayed on the desk before pressing <TRANSMIT> F2!

- Press F2:

After <TRANSMIT> Cockpit displays '**Adaptation X-Ray tube'** (locally programmed language).

READY returns (after appr. 15 seconds).

- Push PREP and EXP button at the control desk or use footswitch.
  The generator will switch about 125 exposures for each focus. The radiation sign at the desk will indicate exposures and a beep will be audible at the end of each exposure.
  There is no display of the actual kV parameters during adaptation.

  The PC screen indicates the end of the adaptation procedure:
  'Before continuing the generator must be reset' and a beep from the PC will be audible.

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- Reset the generator
- Run the adaptation for each focus (small and large).

Note: As there is no tube type with a third physical (middle) focus yet, it can not be adapted. VARIOfocus values are calculated by adapted small and large focus. Programs using VARIOfocus can only be selected until small and large focus are both adapted.

A non-adapted focus will be indicated at the Cockpit screen "**focus not adapted"**, (locally programmed language).

- Reset the generator

Symptoms and solutions if problems occur during adaptation:

1. A warning can not be displayed on the control desk, the "Waiting" screen on the PC is flickering instead during this event. The warning is logged in the error log index.

2. If the tube is already on a high temperature level (but the traffic light still indicates green or green-yellow for 100% power) it might happen that the traffic light changes straight to red and the adaptation is on hold**.** **"Waiting"** is flickering on the PC.
   Solution: Keep the handswitch pressed, once the temperature is down adaptation continues automatically
   Note: An increment of one of the temperature levels inhibits the 100% power condition. This event is always logged as Warning 00BV in the error log index.

3. Generator error messages will be indicated on the Cockpit screen, e.g. "Error 6199999" (is not a generator error, refer to 8.) at the end of this section).
   If any errors occur "Waiting" is flickering on the PC.
   The only way to reset an error is: Let go the PREP- or footswitch which causes an interrupt, (similar to the "reset" command.)

4. After let go of the PREP switch wait until the desk indicates READY. If READY does not appear at least after 20 seconds run a warmstart of the generator via the reset button on CU EZ139.

5. If adaptation seems to do nothing for more than 30 seconds let go the PREP switch. Wait until the desk indicates READY. If READY does not appear at least after 20 seconds run a warmstart of the generator.

6. If a constant READY indication appears for more than 2 seconds while PREP and EXP is activated with the handswitch during adaptation let go the handswitch. Wait until the desk indicates READY. If READY does not appear at least after 20 seconds run a warmstart of the generator.

7. If adaptation does not carry on with or without READY indication check if one of the funcion units indicates a FATAL error by turning on the red LED. Let go the handswitch and warmstart the generator.

8. If adaptation has been interrupted by a generator warmstart check the error log index before restarting adaptation:
   kV errors 02WG and/or 02WH indicate tube arcing. Run conditioning of the tube and/or reduce the max kV value to the required application value.

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